Caput nitidum, parum punctatum. Thorax fere lævis, collari antice magis punctato. Abdomen sub lente punctis delicatissimis undique impressum. Alæ apice parum obscuriores, stigmate luteo-fusco, postice magis fusco.

Fœmina ignota, forsan aptera et mare multo minor.

XXVII. *Remarks on the* Psychidæ, *by Professor* C. Th. v. Siebold, *published in the Silesian "Bericht über die Arbeiten der Entomologischen Sektion im Jahre* 1850." Translated by H. T. Stainton, Esq.

[Read October 6th, 1851.]

I have already endeavoured, in the first year (1849) of the "Zeitschrift für wissenschaftliche Zoologie," to direct the attention of Physiologists and Entomologists to the extremely interesting mode of propagation of the *Psychidæ*, when I maintained that the assertion, that the female individuals of the *Psychidæ* could propagate without the introduction of the semen of the male, was founded on mistake and error.

The whole of the peculiar behaviour of these moths in the business of copulation, as well as when laying their eggs, may easily contribute to lead the observer into error, as may be perceived from the following. The females of many of these case-bearers, after copulation, lay their eggs in the deserted pupa-shell which remains in the case, and fill it with them tightly from top to bottom, so that if these cases are collected and preserved, one may easily fall into the belief they were the cases in which the females had not yet escaped from the pupa. Consequently, when young larvæ afterward crawl out of such cases, one erroneously concludes, that in this instance a female which had been obtained whilst in the pupa state, and therefore had not been impregnated, had *sine concubitu* produced young. But this only concerns the two genera of *Psychidæ*, *Psyche* and *Fumea*, and is not the case with the genus *Talæporia*. I have now arrived at the conviction that the females of the genus *Talæporia*, which formerly I had not learnt to distinguish strictly from the females of the genus *Fumea*, can under certain conditions propagate without male intercourse.

But this occurrence can not be considered as an exception to those physiological laws, according to which all true eggs, in order

to attain their development, must previously be fecundated by the semen of the male; but this phenomenon, observed in *Talæporia*, must be added to those widely spread occurrences in the lower orders of animals which we have but recently learnt to estimate correctly, and now know under the designation of alternation of generation. We should therefore no longer consider the individuals capable of propagation without intercourse with the male, as females endowed with ovaries, but as sexless individuals quite different from females in their organisation. These individuals, sexless, yet capable of propagation, as we have now learned to know them so plentifully among the invertebrata, have been designated *Nurses* by Steenstrup, who first paid attention to the change of generation. These *nurses* can propagate by longitudinal or transverse section, by external or internal formation of germs, or by a germ-stock. This germ-stock supplies the place of an ovary, and renders the presence and influence of a testicle unnecessary. Such a germ-stock produces in consequence no eggs, but germs (germ-grains or germ-balls).

According to this physiological law, only recently recognised, the long known wonderful phenomenon among the *Aphides* is estimated quite differently from what it has hitherto been. There do not occur in them, in the course of a summer, generations and generations of exclusively female individuals one after another without any traces of male individuals, till at last there appears a brood of male and oviparous female *Aphides*, which must copulate and be *impregnated;* but we shall have to consider these viviparous female individuals as sexless nurses provided with germ-stocks. That these *Aphis* nurses, in reference to their organs of propagation, have a truly different organisation from the oviparous *Aphis* females, I have already demonstrated in the year 1839 (see "Froriep's Neue Notizen, Band XII. p. 307). The sexless viviparous *Aphides* want not only the *receptaculum seminis*, which the sexual oviparous *Aphides* possess, but also the germ-stocks of these *Aphis* nurses show an entirely different form and structure to the ovaries of the female *Aphides*. I have already mentioned my suspicion (see my "Lehrbuch der vergleichenden Anatomie der wirbellosen Thiere," p. 634), that the occurrence of sexless nurses among insects was not confined to the single family of the *Aphides*, and that probably also among the species of *Cynips* and *Psyche* similar nurse formations might occur. In the *Psychidæ* this is now certainly the case, since the *Talæporiæ* are subject to such a change of generation. The account of Lepidopterologists (constantly repeated, and from different quarters), that the females

of certain species of *Psyche* had produced young without previous copulation (sine lucina) has compelled me to examine these communications more rigorously; and I chose for investigation *Psyche Graminella* and *Fumea nitidella.*

I soon convinced myself by investigation, that most of the assertions that the *Psychidæ* could propagate *sine concubitu* originated in delusions. I have further explained the errors lying at the bottom of these delusions in the "Zeitschrift für wissenschaftliche Zoologie" (Bd. I. 1849, p. 93).

After I had made known my opinion upon this point, I again continually received, from various quarters, intimations that in certain *Psychidæ*, which were collected as larvæ and taken care of, a propagation *sine lucina* must have taken place, since from such larvæ, after they had gone into pupæ, only females had emerged which had laid eggs, from which afterwards larvæ had certainly come.

These communications, however, mostly referred to *Talæporia lichenella*, Zell., and I now turned my whole attention to the *Talæporiæ*, for which the abundant occurrence of the *Tal. lichenella* at Freiburg in Breisgau, my former abode, was very useful. Unfortunately I was interrupted in these investigations by my removal from Freiburg to Breslau; yet I had prevailed on Herr Reutti, who had undertaken these investigations in company with me at Freiburg, to pursue our observations further. He has faithfully communicated to me the further success of these observations, and so I am now in a condition to announce with certainty, that the *Talæporia lichenella*, Zell., is subject to a change of generation, or rather, *that the Talæporia lichenella*, Zell., *is a sexless nurse*, since the larvæ of this case-bearer produce *nothing* but females, and *always* only again females, which, *sine concubitu*, lay eggs, from which afterwards larvæ actually escape. Apparently these wingless individuals of *Tal. lichenella* with ovipositors do not correspond to females, but to the sexless nurses of a species of *Talæporia*, subject to alternation of generation. How many generations of these nurses follow one another, till at last a sexual generation occurs, has not yet been ascertained.

We must, in the first place, endeavour to find out the sexual form of this *Talæp. lichenella*, since although Zeller (see Isis, 1838, p. 718, 1839, p. 182 and 302) quotes as a synonyme to this case-bearer the *Psyche triquetrella* of Fischer von Röslerstamm, it is not yet ascertained whether both the forms truly belong to the same species. I know the male and female of this *Talæporia*

triquetrella, F. v. R., from my own inspection—for I have often bred it at Freiburg from its three-sided cases, and thereby obtained females and males in tolerable plenty. At any rate the cases of the sexual *Talæporia triquetrella*, F. v. R., and the sexless *Talæporia lichenella*, Z., although the cases of both species appear three-sided, are very different from one another. This difference probably does not originate from the different materials, which these case-bearing larvæ use for the composition of their cases, though, indeed I have always found the larvæ of *Talæporia lichenella*, Z., on old fences, whereas *Talæporia triquetrella*, F. v. R., probably remains, while in the larva state, on low grass plants, and to undergo transformation crawls up on to the stems of trees, and sides of rocks. The former is rarely found but in the neighbourhood of gardens and houses; the latter, on the contrary, occurs at a distance from these, as in woods. The cases of *Talæp. lichenella*, Z., are constantly smaller and darker than those of *Talæp. triquetrella*, F. v. R. Since the cases of these *Talæporia* nurses are probably differently constructed from those of the sexual *Talæporia* individuals, since besides it may be assumed that nurse-forms will also occur *in other* species of *Talæporia*, and that we had hitherto altogether disregarded the alternation of generation of these moths, it cannot fail that the separation of species among the genus *Talæporia*, which by these complicated circumstances is rendered very difficult, must have fallen into the worst confusion.

It is now a problem for Lepidopterologists to investigate further the extremely interesting circumstances of living of the *Talæporia*, in order that the many still unresolved questions, which are associated therewith, may speedily receive a decided answer.

For all those who wish to make the observation and investigation of the *Psychidæ* their task, I will besides suggest the following. It should be sufficient for the present to distinguish only three genera of *Psychidæ; Psyche*, *Fumea* and *Talæporia*. *Psyche* and *Talæporia* form the extremes of this family, and *Fumea* stands as a connecting link midway between the two.

1. *Psyche*. The male has pectinated antennæ; it can elongate its abdomen more or less, and during copulation thrusts it deep into the case where the female remains concealed.

The wingless female is vermiform, possesses neither legs, antennæ nor eyes, and likewise wants an ovipositor. It remains concealed in the case, after its escape from the pupa shell, till copulation has taken place; it then creeps backwards into the deserted pupa-skin and lays it completely full of eggs, when, being quite shrivelled up, it dies.

2. *Fumea.* The male is provided with pectinated antennæ. It can generally stretch its abdomen lengthways. Copulation with the female takes place outside the case of the latter.

The wingless female possesses properly developed legs, antennæ and eyes. The antennæ are moniliform and short, their apices not reaching to the hinder end of the thorax; the abdomen terminates with a telescopic ovipositor (capable of being drawn out and in), the base of which is clothed with many woolly hairs. The female, after its escape from the pupa skin, creeps out of the case, and, firmly attached thereto, waits the approach of the male. After copulation the female, by means of its ovipositor, lays its eggs in the empty pupa-skin which remains in the case, and fills it with eggs and woolly hair; after which, being shrivelled up, it falls off the case.

3. *Talæporia.* The male possesses long, simple, filiform antennæ. It can not elongate its abdomen. Copulation with the female takes place outside the case.

The wingless female is quite similar to the female of a *Fumea;* legs, antennæ, and eyes are developed; the woolly hairs at the end of the abdomen, and the ovipositor, capable of being drawn out and in, are present. The only difference lies in the form of the antennæ. The filiform antennæ are here always longer than in the females of *Fumea;* they either reach to the hinder end of the thorax or extend beyond it. The female on its exclusion creeps out of the case, with the pupa skin attached to it, which falls off when it has completely quitted it; and then the female, having copulated outside the case to which it is firmly fixed, lays its eggs, by means of its ovipositor, in the cavity of the empty case.

On the Spiral Case of the Larva of a Psyche.

This case-bearer, which occurs near Freiburg in Breisgau on stone walls, and has also been found by Kollar on a brick wall at Vienna, must in every respect attract the attention of Entomologists and Physiologists. From most of those which were sent me from Vienna through Kollar's kindness, a *Chalcis* made its escape, which proved to be a new species, and has received from Kollar the name *Chalcis unicolor.* From very few pupæ only have I hitherto bred vermiform females without ovipositors, males having never made their appearance. My attention was first called to the occurrence of the *Psyche* near Freiburg by Herr v. Heyden. I had provisionally named it *Psyche Helix*, but ascertained afterwards that Herrich-Schäffer had already described and figured (Systematische Bearbeitung der Schmetterlinge von Europa, Bd.

II. Fig. 108—109, with case) a male as *Psyche Helicinella*, from specimens sent by Mann, but of which the latter had only suspected that they might have escaped from spiral cases, which he had found in Sicily in the vicinity of their capture. Reaumur (Mémoires pour servir à l'Histoire Naturelle des Insectes, tom. iii. part i. 12o. pag. 249, Pl. 15, f. 20-22) had also already known and described these singular cases, and had bred the *Chalcis* from them, at least we must consider as that the " petite mouches noire et à quatre ailes," which he obtained from these spiral cases. Zeller, in his critical review of the *Lepidoptera* described by Reaumur, has omitted to explain these case-bearers (Isis, 1838, p. 718), but he has expressed his opinion to me in a letter that these spiral cases could belong to no *Psyche*, since the larvæ living therein fed in the way of the larvæ of *Coleophora*. The latter fact has Reutti also communicated to me from Freiburg. I had on my removal from Freiburg specially recommended to him the further observation of these extremely interesting case-bearers. But hitherto no *Coleophora* has been produced from these cases. In short, up to the present time no Entomologist, who has had opportunity to observe the case-bearers, has had the good fortune to breed from them winged *Lepidoptera*. Neither Reaumur nor I, and just as little (according to oral and written communications) Kollar, Mann, Zeller or Reutti can boast of it. This is most extraordinary, and must especially stimulate our interest in these case-bearers. I therefore beg of Entomologists to devote all their attention and care to this extremely interesting subject. Any notice thereon I will receive most thankfully.

The discovery of these spiral cases will probably happen in the North of Germany, and even here in the province of Silesia, since according to a written notice, for which I am indebted to Herr Zeller, he has found these cases generally distributed (and also near Glogau). In Italy he had met with them abundantly on the olive trees; he had also observed them on Anthyllis vulneraria, Lotus corniculatus and Gnaphalium arenarium, which plants the larvæ really fed on. Near Vienna I collected these case-bearers, in the pupa state, only on a wall much exposed to the sun, in the immediate vicinity of which grew Atriplex laciniata, on which plant, according to Kollar's assertion, these case-bearers feed in the larva state. I may here incidentally observe, that at the same place I met with the pupæ of *Coleophora auroguttella*, the case-bearing larva of which likewise feeds on Atriplex laciniata.

From Reutti I afterwards learnt that he had ascertained that the Artemisia vulgaris, which grew in the vicinity of the head quarters of the spiral cases, on the castle-hill at Freiburg, was the food of the larvæ belonging to these cases.

From all that has hitherto been ascertained of these case-bearers I am inclined to suspect that the vermiform insects, so like the females of *Psyche*, which escape from the pupæ of these case-bearers, are not truly females, but correspond to sexless nurses, as in *Talæporia lichenella*, Zell., which, *sine concubitu*, can produce young.

I have long cherished this suspicion, since I had observed, partly in Freiburg and partly here, several hundred cases, which never produced a single male moth, but either a *Chalcis*, *Pteromalinæ*, or a vermiform female. Each case which I collected spun-up, and afterwards opened, I had become certain beforehand that it contained a female pupa or the remains of one. Many pupæ appeared empty or dried up; some were filled with eggs, or, to my astonishment, with hexapod larvæ.

It follows from this, that on the exclusion of the so-called female of *Psyche helix*, the pupa skin remains in the case, and that the female understands to lay its eggs in the empty pupa-skin, wherein the animal reminds one of *Psyche* and *Fumea*. From a later communication received from Reutti I perceived that he has observed the same thing; indeed that from such cases, of which he had isolated the larvæ and allowed them to undergo their transformations, he had afterwards found the pupa-skins filled with young larvæ, from which it becomes a certainty that these case-bearers with spiral cases furnish nurse-formed beings, the sexual individuals of which have not yet been discovered.